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A MAGAZINE DEVOTED TO THE INTERESTS OF RADIO, HI-FI AND TV TECHNICIANS IN CANADA

ROGERS BOOSTER

cover story

At 1133 St. Clair Avenue West in Toronto, there is a smart 15,000 square foot store where Steven Goldfarb carries on a TV-radio service business and sells a wide range of products from TV and hi-fi to furniture.

This winter "Steve", as he's known to hundreds of West Enders, expects to take off with his wife to Bermuda on his first holiday since he came to Canada in 1948.

"You could say I've worked hard but I've done well here too," says Steve. "That's the difference between Canada and Europe. In Canada, if you work hard you get ahead."

Born in Romania in 1920, Goldfarb studied electronics at a polytechnical school in his own country. After the war he went to Germany and then managed to get to Canada on a labor immigration quota.

He had to work under government contract for a year on a laboring job. After that he was free to find his own place in his new land.

He certainly had no special advantages to start off with in Canada.

"I remember I had just $10 when I landed. It was given me by a welfare agency and I had to pay it back later," says Goldfarb.

At first after his labor commitment was finished he worked in other people's stores. Then, in 1950, he opened a little store on Vaughan Road, specializing in service.

"I didn't have the capital to carry on selling too," he says.

In 1950, too, he got married. He now has two children, Peter 10½ and Diane 5.

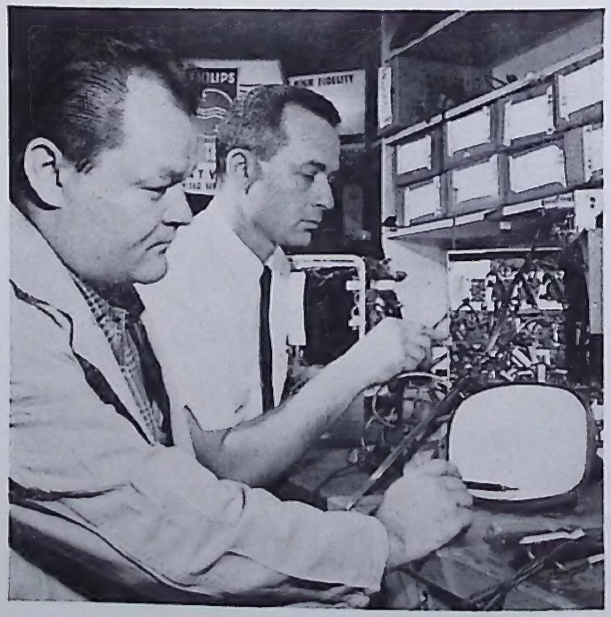
By 1957 business had progressed enough for him to move to a larger store on St. Clair and then, two years ago, he also occupied the store next door – the total making up his present premises, under the name Radion TV Limited.

His staff consists of two servicemen, two drivers and a salesman, with extra help coming in on weekends.

One of the unusual things about his business is that Goldfarb carries an unusually complete line of service parts.

"I believe it's only good service to the customer to carry a complete line," says Goldfarb. "I can even supply tubes for radios made in 1926."

"I've certainly got no complaints about the way Canada or the TV business has dealt with me," he says. "At the same time, I've really worked mighty hard, and I'm looking forward to that holiday, believe me."



technical section

Servicing Series B+ Systems

Since the vacuum tube was first introduced, electronic devices have required different levels of supply voltage. For example, the simplest of the early radio receivers required a lower voltage for the detector (usually a "soft" tube) than for the audio amplifier. With battery-supply the solution was simple, the detector being connected to a 22½ volt tap, the first audio to a 45 and the second audio to a 90.

Later, with a.c. as the original source, this arrangement became impractical because, even though the transformer secondary could be tapped, a separate rectifier and filter system would have to be used for each voltage. Consequently, the d-c output voltage was designed to meet the maximum requirement (usually from 250 to 500 volts) and a voltage divider was connected across it. This had two drawbacks, one being the energy lost (and heat produced) by the various plate currents flowing through the divider. Secondly, there was still further energy wasted by the bleeder current flowing in the divider and, for good voltage stability, this had to be substantial.

We next find our circuitry using individual voltage-dropping resistors which eliminated bleeder current and distributed the heat around the chassis instead of concentrating it in one spot.

In a radio receiver with 5 to 8 tubes the total power involved was relatively small and the heat easily dissipated. All was well until the TV receiver with, say, 20 tubes came along. In spite of the great size of the chassis, the early TV sets became as hot as the often-referred-to hinges on the place where bad technicians go.

Right here is where our circuit designers had a bright idea – why not use one section of the receiver, requiring a specific plate voltage, as a voltage-dropping resistor for another section? Thus was born the series B+ or stacked B+ circuitry found in modern TV receivers.

Examples

Figure 1(a) is a block diagram of one of the simpler arrangements. The voltage across a video i-f stage is commonly 125 volts so two such stages have been connected in series across a 250-volt supply.

It is important, of course, that each stage be designed to pass the same current (i.e., have the same resistance) so that the voltage divides equally between them.

A further development is shown in Figure 1(b) where the audio output stage (which requires considerable current) is used as one half of the divider. The other half consists of a number of stages which individually draw less current but collectively draw as much as the first half. Total plate and screen current of each i-f stage may be around 15 ma. and the sync circuits may draw about 10 ma. This makes the cathode current for the audio output tube about 40 ma. and approximately the same voltage appears across each section.

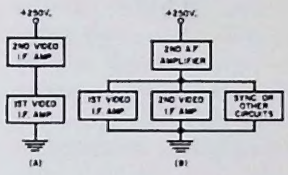


Fig. 1

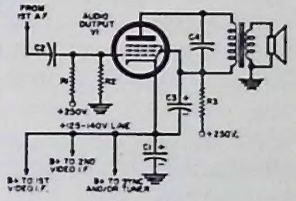


Fig. 3

A Typical Circuit

Connecting two stages in series across the B+ may introduce some difficulties due to differences in emission between two tubes. To compensate for this and to improve a.g.c. action, the circuit of Figure 2 was developed. R5 and R6 form a voltage divider and regulator and maintain the control-grid voltage of V2 reasonably constant. When a.g.c. voltage is applied to the grid of V1, the plate current of V1 will decrease, increase the voltage drop across the tube and thus raise its plate voltage. Note that this rise in voltage at point A also occurs at point B and increases the cathode voltage for V2. With V2 grid voltage stabilized, the change in cathode voltage alters the tube bias and reduces plate current in both tubes to a considerable degree. The result is a very effective a.g.c. action.

Effect of a Weak Tube

As an example of this, let us suppose the emission of V2 falls off. The fixed grid voltage will prevent an excessive voltage drop across the tube by changing the grid-cathode bias and causing the tube to conduct more. This occurs because, as the voltage drop across the tube begins to rise, the cathode voltage falls and approaches the value of the fixed grid voltage. This reduction in bias causes increased conduction, increases the gain and allows V1 to conduct more nearly at its normal value.

Series Audio Tubes

An audio output stage that serves as a series-dropping device for several other stages is shown in Figure 3. This arrangement was shown in a block diagram in Figure 1(b). The clamping voltage for the grid (which will be a few volts lower than the cathode) is established by the divider R1 and R2. This fixes the approximate voltage on the low B+ line. As was the case in the circuit of Figure 2, the fixed grid voltage tends to compensate for variations in the emission of the output tube.

Capacitor C1 serves as a decoupler to prevent audio signal variations from reaching the other stages via the 125-140 volt line.

Troubleshooting

Series B+ systems create special service problems because a defect in one tube or stage can affect performance of one or more of the other related stages. The pattern of such changes depends upon the specific relationships among the affected circuits and this pattern varies with different configurations. For this reason a standard fault-finding procedure cannot be established.

The first requirement is an understanding of how the circuit operates. After that, tracing out what happens in the case of some possible defects can be most helpful. Let us consider a couple of examples.

In Figure 2, if R6 should become open, V2 conduction would become excessive and the voltage at point B would rise to a level almost as high as the high B+ line. There would be little if any a.g.c. action and the symptoms would be similar to those associated with a.g.c. faults.

In the same circuit, if R5 opened, V2 would be biased excessively with its control grid near ground potential. This would cause a drastic reduction in current in both tubes. However, V1 will still try to conduct normally and, since it has a lower resistance than V2, the voltage at point B will be much lower than normal.

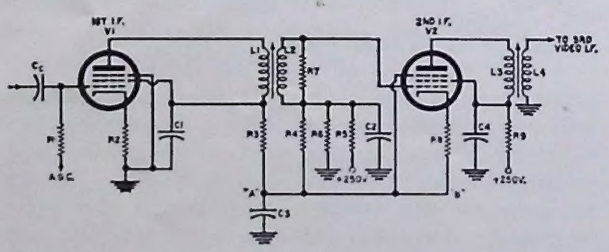


Fig. 2

Resistors R1 and R2 in Figure 3 will affect the 125-140 volt line in much the same way as R5 and R6 in Figure 2 affect the lower B+.

Such examples, of course, are almost endless and there is only about one general rule that can be applied. That is—voltages for any stage should be measured with reference to the specific B— point as it appears to that specific circuit. Thereafter, standard localization procedures may be followed.

ARTICLE II

The Relay in Industrial Electronics

A standard definition for a relay is "a device that is operated by a variation in the condition of one electric circuit to effect the operation of other devices in the same or another electric circuit". In industry, all control was handled by relays before electronics entered the picture and even now the majority of industrial control circuits use relays of one or more types. The older types of relays used in electrical circuits followed a fairly familiar pattern but the introduction of electronics has lead to certain changes in design and we will often run into some strange-looking devices that don't appear to be relays but actually are.

The relay dates back to 1824 when an Englishman named Sturgeon invented the electromagnet and to 1829 when Joseph Henry added an armature which carried contacts.

Mass production and adaptability to new circuits has lead to some changes in design but Henry's principle remains the basis of most relays.

Later, when alternating current transmission was inaugurated about 1886, some modification had to be made in the basic relay design. In 1901 Westinghouse introduced the induction relay.

Only in recent years have new principles been applied to relays, these principles being made available by new materials in the electronics industry. One such development uses the piezoelectric characteristics of artificial materials to produce mechanical motion. Other means of switching by non-moving devices, such as magnetic amplifiers, vacuum tubes and transistors, are available but the relays we are to discuss here still depend on mechanical motion for their operation.

2. Classes of Relays

Relays may be classified by the method used to convert electrical power to mechanical motion. For d-c circuits there are the clapper and the solenoid types. Figure 1 shows the basic construction of clapper relays and the operation is fairly obvious. A spring exerts tension so that the armature is held upright and the upper contacts are closed. N.C. indicates they are normally closed. When current is permitted to flow through the coil, the core is magnetized, the armature is pulled down, the N.C. contacts open and the N.O. (normally open) contacts close. Thus, this relay may be used to open one circuit and close another or to perform one of those functions only.

The solenoid type is similar in construction but the core is not securely fixed within the coil but is attached to the armature. When current is passed through the coil or solenoid, the core or plunger is pulled into it by the magnetic field and this permits a greater distance of travel of the moving elements.

The solenoid principle is particularly adaptable to time-delay relays because it is only necessary to add a dashpot to delay the closing of the contacts after the actuating voltage has been applied to the coil. The dashpot consists of a piston that moves within a cylinder and compresses the enclosed air which is permitted to escape through a very small opening. To a large extent the speed with which the piston moves is determined by the size of the opening. Initially, the air in the cylinder can be compressed to a certain degree so that the time characteristic is not linear. However, it can be made nearly so by subsituting some non-compressible medium such as oil. The use of oil will also increase the time delay for a given size of escape opening and a given distance of travel.

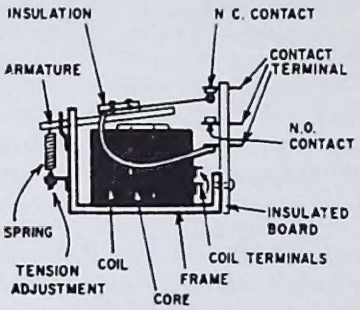


Fig. 1

A-c relays also use the basic design of the clapper and solenoid types but their magnetic structures must be laminated as is shown in Figures 2 and 3. Laminated cores are used for the same reason as in transformers; that is, to avoid the production of heat and wasting of energy due to eddy currents.

When a d-c relay is used on a-c it will tend to chatter because the magnetic field weakens as the alternating current falls from its peak value. Consequently, another feature of the a-c relay is the shading coil which consists of a single turn of copper around a part of the armature or core. This turn acts like a shorted secondary on transformer and the current induced in it is approximately 90 degrees out of phase with the current in the coil. When the magnetic field of the main coil falls in strength, the shaded portion of the core retains its magnetism and holds the armature in place against the force of the spring that is trying to pull it away.

Another very common unit is the induction relay. These have such industrial applications as protecting large generators and motors, comparing the currents in the three lines of a three-phase system and determining whether the current is flowing in the proper direction. Most induction relays incorporate some time delay, the delay often being inversely proportional to the current. The delay occurs because their operation depends on a motor action which requires time to function.

The principle of operation is similar to that of a watt-hour meter and is illustrated in Figure 4. It consists of an aluminum disc mounted on a shaft and rotating between the poles of a shaded electromagnet and a permanent magnet. Eddy currents induced in the disc by the main portion of the electromagnet pole are in phase with the currents in this coil but out of phase with those in the shaded polepiece. The eddy currents generate a magnetic field out of phase with those in the shaded polepiece and repulsion between the two causes the disc to rotate.

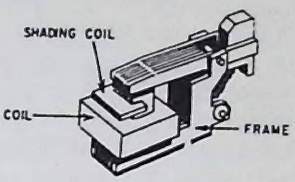


Fig. 2

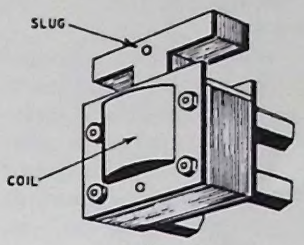


Fig. 3

When the disc moves, it also has eddy currents induced in it by the permanent magnet, and interaction of these two fields slows the disc. Thus, the position of the permanent magnet controls the speed of rotation. The spring retains the disc until the current is great enough to move it and returns the disc to its starting position when the current subsides.

The unit shown is a very elementary type. More complicated forms will be found using a number of coils above and below the disc to control the operating characteristics.

Special Types

One of these is the thermal relay that uses a bi-metal strip to operate contacts. These are often found in circuits employing vacuum or vapor tubes where they delay the application of plate voltage until the filaments or cathodes are heated. This type is illustrated in Figure 5.

Where great sensitivity is required, the meter relay is often used and this is shown in Figure 6. It consists of a d'Arsonval movement and a pointer that carries very small contacts. The contacts close when the pointer is deflected a pre-set amount. Sensitivity is adjusted by changing the position of the stationary contacts, which is usually done by the use of a screwdriver or a knob on the instrument.

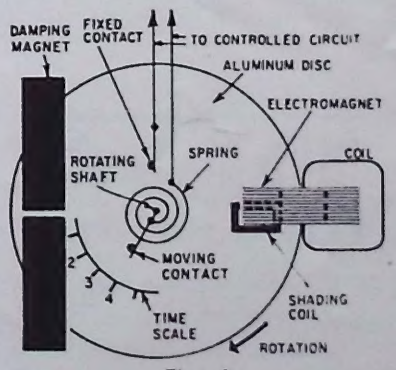


Fig. 4

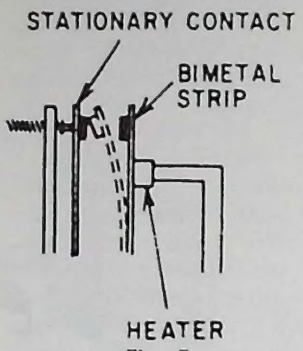


Fig. 5

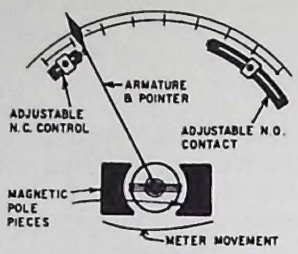


Fig. 6

Figure 6 only illustrates the principle of operation and the construction of early types. In modern versions the contacts are not on the pointer but on a special yoke and the pointer serves only as an indicator.

Another type now available is the piezo-electric. It uses a barium titanate slab, the shape of which becomes deformed when a voltage is applied to electrodes on its surface. The mechanical movement resulting from this distortion is used to close contacts. See Figure 7.

The Stepping Relay

Ratchet or stepping relays are special developments of the clapper type. A simplified drawing is shown in Figure 8. Through a pawl-and-ratchet arrangement the shaft and contact arm are advanced one notch each time the relay armature is actuated. Thus, the arm advances to each contact in sequence. In this model, rotation is continuous and the arm eventually returns to the first contact.

Reed Relays

Frequency-sensitive reed relays will also be found in some applications. In these the armature is a tightly-clamped tongue or metal strip having some natural resonant frequency. (See Figure 9.) When the current in the coil reaches this frequency, the tongue vibrates and its contacts open and close many times per second. A slow-opening auxiliary relay is kept closed by this periodic contact until vibration ceases. One electromagnetic may carry a number of reeds, tuned to different frequencies, so that different contacts can be closed by different frequencies.

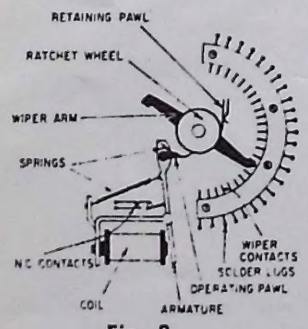


Fig. 8

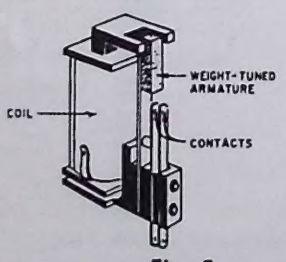


Fig. 9

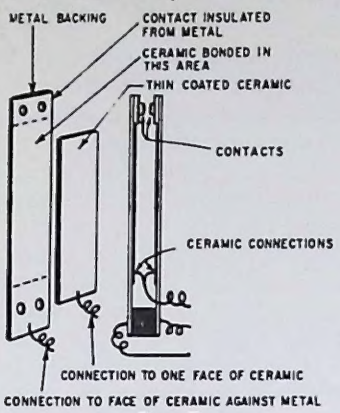


Fig. 7

Relay Characteristics

Many relay characteristics (current and voltage requirements for example) can be controlled. Most can be equipped with different coils to accommodate different voltages. The magnetic structure and the tension of the armature spring will determine the ampere-turns of the coil.

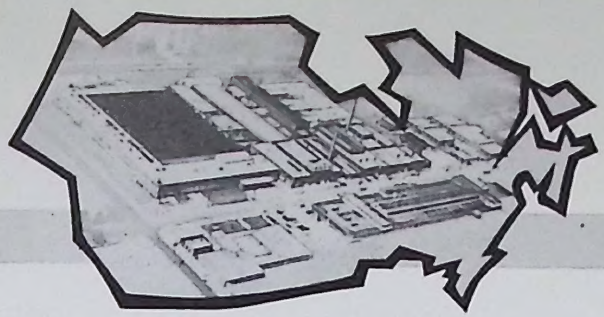
Another characteristic that often has to be controlled is the operating time. Dashpots have already been mentioned and there the size of the escape orifice and the nature of the material in the cylinder (air or oils of various viscosities) are the chief factors.

A non-mechanical method for controlling time is the use of copper slugs. A slug at the heel end makes the relay slow-closing and a slug at the armature end makes it slow-opening. Slugs at both ends make the relay generally slow in operation. The principle of operation is similar to that of the shading ring previously discussed; that is, currents induced in the slugs produce either opposing or assisting fields so that total magnetization is either delayed or caused to "hang-over" after the current drops off.

The size of the slug determines the time delay and delays up to one-half second can be obtained. (Not long enough, of course, for some applications such as delaying the application of anode voltages.)

Combinations are sometimes used. For example, a vibrating-reed relay may be used to operate another relay of the slow-operating type.

Another controllable feature is the relay's sensitivity to polarity. Polarized relays are usually of the clapper-type, have two coils and the armature has some permanent magnetization. An applied voltage of one polarity will assist the magnetization of the armature in one direction and oppose it in the other. The armature then moves in one direction and closes one pair of contacts. Reversal of voltage polarity will reverse this situation, the armature movement reverses and another pair of contacts closes.



industry news

Booster Industry News

BBG Briefs—The Board of Broadcast Governors has shelved its policy of not allowing new radio stations in the eight cities that have second TV stations. After January 1st it will hear new and pending applications for radio stations in and around Halifax, Montreal, Ottawa, Toronto, Winnipeg, Edmonton, Calgary and Vancouver. . . . Of 12 applications for TV rebroadcasting stations, seven were approved. These were Greenwater Lake and Nipawin, Sask. (for CKBI-TV Prince Albert), Wynyard, Sask. (for CKOS-TV, Yorkton), Burmis, Alta. (for CJLH-TV, Calgary), Drumheller, Alta. (for CFCN-TV, Calgary), Sioux Lookout, Ont. (for a new CBC station at Dryden) and Courtney, B.C. (for CBUT, Vancouver).

No UHF for Canada—The BBG is taking no steps similar to the latest in the U.S. to open up UHF TV in Canada. In the U.S. the object is to encourage greater competition and more educational stations. In Canada, the BBG feels there are enough VHF channels available (outside of Toronto and Montreal) to meet the needs of the industry. In the U.S. at present, only 75 of the 1543 available UHF channels are in use.

Highest in Canada – The new tower for CFPL-TV in London, Ont., will be the highest TV tower in Canada. It will be exactly 911 feet high and, when topped with a 67-foot antenna, will have an overall height of 1840 feet above sea level. (The height will change by as much as 12 feet under summer and winter conditions). For viewers in the immediate London area it will have no effect but will relieve the spotty reception in a 70 to 80-mile radius. Sarnia, Chatham, Kitchener and Wallaceburg will benefit from the increased height.

The Ford-Philco Deal—The planned purchase of Philco Corporation by Ford Motor Corporation for an estimated $100 million-plus is expected to result in a vastly stronger defense, industrial and consumer electronic position for the automobile giant. Henry Ford II commented that the stock deal would "make possible a fuller participation by our company in the national defence and space effort". Philco will be operated as a subsidiary and not as a division of Ford.

Philips Meets the Import Challenge—The Tube and Component Division of Philips Electronics Industries is now prepared to supply all manufacturers with a new design and most of the essential parts for a transistorized cordless mantel radio to retail for not more than $30. The new circuit matches the performance of more elaborate receivers chiefly by the use of the new alloy-diffused transistors. Details of this new development appeared in the October issue of New Trade Builder.

An 8-Tube TV Set—In Wheeling, Ill., Muntz TV will go into pilot production of a TV set using eight tubes. The 19-inch set employs eight multipurpose tubes along with a specially-designed low-drive picture tube and will retail at about $100. It has only one i-f stage and sensitivity is limited but "adequate" reception is claimed up to 50 miles. While full production is now planned for this model only, work is in progress on a seven and even a five-tube set.

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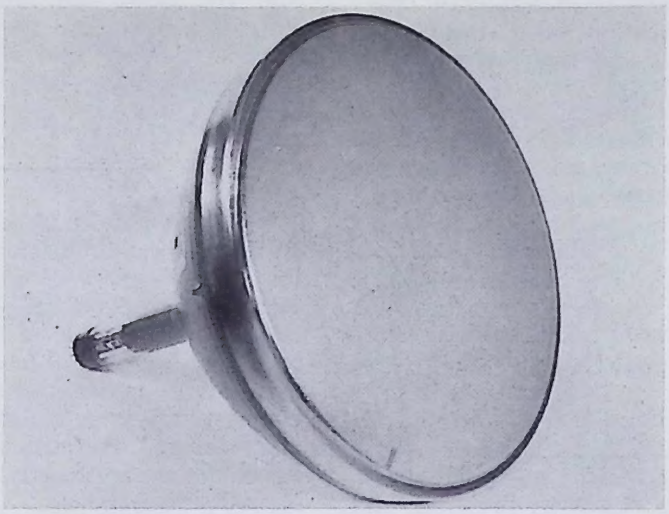
what's NEW?

in semi-conductors, tubes and components

NEW COLOUR PICTURE TUBE FROM PHILIPS

Philips has announced recently the introduction to the Canadian market of a new direct-viewed, round, all glass shadow mask colour picture tube, designated – 21CYP22/AX53-12



The new Philips tube produces a picture of superb quality in colour or black and white, measuring 19¼" x 15½". Picture area is 261 square inches. The metal backed three-colour phosphor dot screen and the filter glass faceplate ensures a high light efficiency and optimum brightness guaranteed to please the most critical customer. Overall dimensions of the tube are 25-1/32" long x 20-13/16" high.

Check with your local Rogers Tube distributor for price and delivery as Canadian stocks have been established.

A detailed brochure is available describing the new tube and may be obtained by writing to "The Editor".

TIPS FOR TECHNICIANS

Booster Service Tips

Service Bench Aids—Although we have all the standard service instruments on our bench, one of the most useful items is an old transformer-type table-model radio with phone jacks to take off the signal at the detector for testing amplifiers, audio circuits, etc. Another jack cuts into the audio amplifier for testing record players, circuit substitution, etc. Another connects to the speaker output for testing speakers.

Another thing that speeds up work and helps to keep the bench neat is a large speaker on the wall with a 2-amp fuse in series. This connects to phone jacks along the bench panel. About a dozen 4-foot patch cords with different types of speaker connectors on each are at hand to couple whatever is being worked on to the wall speaker. This is especially handy if much car radio work is done.

KEN WINTERBON, Brantford, Ont.

★ ★ ★ ★ ★ ★

Published by Rogers Electronic Tubes & Components, a Division of Philips Electronics Industries Ltd., 116 Vanderhoof Ave., Toronto 17, Ontario